

Industry 4.0을 통해 본 독일 혁신정책의 특징

이범규1), 이상빈2), 성은현3)

Characteristics of the German innovation policy in industry 4.0

Byeouk-Gyu Lee3), Shang-Bin Lee2), Eul-Hyun Sung3)

요 약

본 논문은 산업국가를 중심으로 현재 진행 중인 4차 산업혁명을 맞이하여 독일정부가 추진하고 있는 국가정책의 특징을 조명한다. 특히 독일정부차원에서 추진되고 있는 인더스트리 4.0을 통해 4차 산업혁명에 대응하는 정책의 특징을 밝힌다. 소위 4차 산업혁명이 일고 있는 새로운 시대는 대량실업과 같은 부정적 요인도 내포하고 있다는 것이 일반적인 전단이다. 본고에서는 인더스트리 4.0의 본성은 독일의 산업과 같은 산업국가가 이러한 부작용에 대해 어떻게 대응하고 있는지를 분석한다. 이를 위해 먼저 독일혁신시스템을 인더스트리 4.0정책의 실행조건으로 설정하고 이 실행조건의 특수성을 밝힌다. 자유 시장경제체제와 사회적 시장경제체제는 시장경제체제의 대표적인 두 가지 유형이다. 이러한 유형의 혁신시스템의 구조에 미치는 영향을 크게 두 가지 유형으로 분류한다. 그리고 사회적 시장경제체제에 기반한 독일혁신시스템의 특수성이 바로 독일의 새로운 혁신정책, 인더스트리 4.0의 고유한 특징임을 밝힌다.

핵심어: 4차 산업혁명, 혁신정책, 혁신시스템, 인더스트리 4.0, 독일혁신정책

Abstract

This paper deals with the characteristics of German innovation policy at the edge of the fourth industrial revolution. The focus here is on Industry 4.0, which is based on the research cooperation of the German Federal Government and a project of the same name in the high-tech strategy of the German Federal Government. There are many analyzes of Industry 4.0. But the socio-political aspect of this innovation policy in Germany; such as mass unemployment and the associated German strategy in the innovation system has hardly been examined so far. This article thus examines whether German innovation policy has already taken account of a socio-political aspect of politics such as mass unemployment in the development and design of new technologies in the context of the fourth industrial revolution. Above all, the relevance between the special features of the German innovation system and the characteristics of the Industry 4.0 is

Received(June 5, 2018), Review Result(June 15, 2018), Accepted(July 13, 2018), Published(August 31, 2018)

1)(Research Professor, Corresponding Author), Science & Technology Knowledge Institute, Chungnam National University, 99 Daehak-ro, Yuseong-gu Daejeon, Korea, email: ittea@hanmail.net

2)(Professor) Dept. of Advanced Industry Fusion, Changwon National University, Yeuchang-gu Changwon Daehak-ro 20, Changwon, Kyungnam, Korea, email: chinah@hanmail.net

3)(Research Professor) Science & Technology Knowledge Institute, Chungnam National University, 99 Daehak-ro, Yuseong-gu Daejeon, Korea, email: ehsung@cnu.ac.kr

* This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea(NRF-2018S1A3A2046546)
analyzed. Particularly, the type of market economy as general conditions of the system of innovation is illuminated.

Keywords: The fourth industrial revolution, Innovation policy, Innovation system, Industry 4.0, German innovation policy

1. Introduction

The edge of the fourth industrial revolution presents to us a technology similar to the head of Janus. Social problems such as unemployment, and technological progress plays a controversial role in the development of this technology. On the one hand, it presents itself as the product of purposeful, intentional human activity. On the other hand, the technology like an inscrutable process presents an opposition to us, which is largely withdrawn from man's guiding hand.

Whether artificial intelligence, 3-D printers or self-propelled cars: the fourth industrial revolution and current technical developments, will change our way of living and working fundamentally.

In the '70s and '80s of the last century, there was a perception that, technical progress was the cause of many social problems. However, today, we know that the conditions are more complicated, especially because the causal link between economic innovation process and social problems is extremely mediated and cannot be packed into simple formulas. In general, the historical experience shows that many innovations have a considerable potential for solving societal problems, but a prerequisite for this potential is that the problem dimensions has to be already taken into account in the development and design of new technologies. By doing this, it counteracts serious mistakes in terms of unemployment, growth, and the environment.

This paper deals with the characteristics of German innovation policy at the edge of the fourth industrial revolution. This paper examines especially whether German innovation policy has already taken the problem dimensions into account in the development and design of the fourth industrial revolution. The socio-political aspect of this innovation policy in Germany; such as mass unemployment, and the related German strategy in innovation system has so far rarely been illuminated. Above all, the relevance between the special features of the German innovation system and the characteristics of the Industry 4.0 is analysed. Because of the strong influence of the economic and social system surrounding innovation system, this section is followed by the relationship between innovation system and the type of market economy as a theoretical framework.
2. Theoretical framework

There is no unanimous opinion on how innovation policy should be conducted. The analysis of the proposed and/or practiced strategies shows very different innovation policies. Nonetheless, a clear contrast is shown between market-oriented and interventionist innovation policies. This article presents this as a basis for the theoretical framework. Most innovation policies can be assigned to one of the two alternative basic streams.

Since the collapse of the Soviet Union’s social and economic system (end of the 1980s), the central administration economy and the planned economy no longer play a role as a "counter-model" to the market economy. Rather, different types of the market economy have developed, and today they compete against the background of globalization; namely, the Anglo-Saxon free market economy, continental European social market economy, and in particular those that originate in Germany[1].

Free market economy and social market economy differ in terms of the scope they offer in different social areas to the functioning of the laws of supply and demand, and where they intervene through state policy. In the free market economy, these scopes are very far-reaching, while the state in the social market economy tries to avoid the deficits and shadows of the market by means of a political strategy[2].

German national innovation systems are emerging within the framework of social market economy, and the pursuit of consensus between the social forces is an important pillar of conflict regulation, with the central levels of the participating associations playing an important role.

In the following, these market-compliant innovation policies and interventionist innovation policies are presented as both alternative basic concepts and their differences are elaborated.

Differences in the strategic orientations of innovation and technology policy can be determined by numerous parameters. Based on these parameters, two alternative fundamental flows of innovation policy can be stylistically juxtaposed; specifically, market-compliant and interventionist innovation policies. These parameters are:

(a) The primary objectives: The objectives of market-driven innovation and technology policy are to accelerate technological progress and improve the international competitiveness of the regional economy in order to boost economic growth and create new jobs. But advocates for interventionist Innovation and Technology Policy(IITP), consider the design, social domination and active influence of technical change to be indispensable to achieve social goals and a
sustainable increase in social prosperity[2].

(b) Dealing with market and innovation processes: Policy may seek to intervene in market processes to achieve the desired result. For the protagonists of a market-oriented policy, it is to a large extent to be accepted that state policy is primarily confined to the design of an optimal framework for the market-driven processes, and that state policy only intervenes if the market control fails; in cases of "market failure"[2]. But the advocates of an active, interventionist ITP, value the performance of the market control much more pessimistically than the protagonists of a market-conform policy. Therefore, the active design policy is regarded not only as necessary, but also as possible and feasible, because the innovation process is interpreted as a social process and therefore variable and controllable.

(c) The depth of intervention of the selected control instruments: This parameter refers to the limitations of instruments "external" control on the market processes. In order to ensure non-intervention in the mechanism of action of the market, in the case of a market-consistent innovation policy, policy-making instruments with a low degree of intervention are chosen. The design of the framework conditions, the creation of an innovation-friendly climate and the technological optimism in economy and society are the main factors. "Hard" instruments in the form of money management are geared towards the funding of basic research because of the general diagnostics of "market failure", as-well-as the expansion of the scientific and technical infrastructure, plus the support of the transfer of knowledge and technology between science and industry. However, in the case of advocates for interventionist innovation policy, innovation policy is not directed solely towards the differentiated, targeted acceleration of technological change, rather it is oriented towards overall social objectives and must therefore be integrated into a macroeconomic strategy of long-term prosperity. This requires, within the framework of the interventionist concept, a legitimate guarantee, which is to be ensured by means of suitable flanking strategies and structures of consensus formation plus social balance of interests[3].

(d) The degree of legitimate guarantee of the political strategy pursued: Consultation with the social consequences of technological change is not considered necessary in the context of market-oriented innovation policy, as the market, in the opinion of the promoters of this concept, optimizes technological change according to the needs of consumers. The state is regarded as a strong body of law, which takes and implements the necessary innovation-policy measures in the sense of social goals. A broad consensus-building is considered superfluous because, the state acts as a "good representative" of the society. While targeted interventions in innovation and structural change processes are also a matter of concern to the advocates of an
active, interventionist ITP as well as the goal-oriented use of all available resources, that is, both "hard" and "softer" steering instruments[4].

3. Special features of the German innovation system

Strengths and weaknesses of the overall innovation activity result from the institutional characteristics of the respective innovation system. Particularities of the German innovation system result from specific characteristics of the components and relationships that make up an innovation system. For the German innovation system, numerous characteristics of its components and relationships can be worked out.

Innovation systems are always part of an economic or social system that includes several subsystems (e.g. the production system and the financial system), each of which has specific functions. The main function of the innovation system is the generation of new knowledge and thus the stimulation of permanent change and innovation processes in all areas of society, especially in the economy and in the production system[5].

Particularities of the German innovation system result from the specific characteristics of the components and relationships that make up an innovation system. The working group of industrial research associations (Arbeitsgemeinschaft industrieller Forschungsvereinigungen: AiF) is a good example. The AiF is an industry-led organization with the aim of initiating research for small and medium-sized enterprises. Above all, AiF facilitates access to technological progress for the SMEs. So that SMEs can continue to be a stable basis for the German economy in the future and maintain their international competitiveness. This program is supported through funding by the state, but the administration of the AiF is not under the influence of the state.

The heart of the AiF is the Industrial Community Research (Industrielle Gemeinschaftsforschung: IGF). It fills the gap between basic research and economic application. New technologies are processed here for entire economic sectors or often across sectors. Companies accompany the research work that is geared to their needs and interests. The IGF results are open to all interested parties. They are the precursor for company-specific developments. In Germany, for example, companies are not only involved in a work-sharing based system, but also in a cooperation system[6].

In addition, the Fraunhofer Society (Fraunhofer Gesellschaft : FhG) is one of the institutional features of the German innovation system, which is the strength of German innovation activity. The Fraunhofer Society for the Advancement of Applied Research is the largest non-university
research organization for applied research and development services mainly for SMEs in Europe with around 24,500 employees[7].

Dual training (also called company training) is also an institutional peculiarity of the German innovation system. This is the most common form of vocational training in Germany. More than half of all German adolescents, according to the Federal Statistical Office, start dual training. The model, which is only available in Austria and Switzerland to date, is admired worldwide and is becoming a model for more and more countries[8].

In addition, the innovation systems and innovation networks are strongly regionally oriented, including the dual training system, AiF and Fraunhofer Society[9].

4. Characteristics of the Industry 4.0 as a German innovation policy.

The characteristics of the Industry 4.0 as a German innovation policy lie in the fact that the problem dimensions are already taken into account in the development and design of new technologies in order to; counteract a serious mistaken development in terms of unemployment. These characteristics of innovation policy are based on the social market economy and the German innovation system. Within the framework of the social market economy, the state is obliged to align its economic policy with the "magical square" of the macroeconomic objectives (high employment, monetary stability, external equilibrium, adequate economic growth). Trade unions and employers' organizations play an important role not only in shaping the parameters of the labour world (labour conditions, labour time, company training, etc) and income distribution (regular bargaining and wage agreements) but also in vocational training policy and labour market policy. In addition, employees are entitled to the right to participate in the company and on the management level. Therefore, the characteristics of innovation policy are based on the social market economy and the German innovation system[2].

A full implementation of Industry 4.0 would mean a structural change for all sectors of the economy. Across all studies, there is an increased demand for IT and data analysis, engineering, research, development and production planning professionals[10]. The necessary framework conditions that enable the use of new technology for Industry 4.0 are available in Germany. Strategies for tackling key challenges that need to be mastered in order to implement Industry 4.0 have already been included in Industry 4.0 as German innovation policy. It is important to always be familiar with new hardware and software in order to be able to produce digitally in the factory of the future. This means, without a good education, the
digitization of the goods production will be difficult. SMEs need more computer technology, measuring technology, which was not the case before in normal CNC(Computerized Numerical Control) work. It is important that the necessary innovation systems for SMEs exist in Germany, such as the dual training system, AiF and FhG. This is a Characteristic of the Industry 4.0 as the German innovation policy.

With these institutional features of the German innovation system, the German innovation policy of Industry 4.0 considers the design, social domination and active influence on technical change to be indispensable in order to achieve social goals and a sustainable increase in social prosperity. It is primarily believed that the digitization will lead to mass unemployment. This is supported by some literatures that state that; jobs in the service line such as public administration, retail, cashiers, accountant, and librarian are relatively more vulnerable. But after the result of a recent forecasts on behalf of the Federal Ministry of Labour in Germany, the digital revolution, leads to even more jobs in Germany which is strong in the manufacturing sector, because Industry 4.0 mainly deals with the digitization of the production process. The new technologies are used in a variety of traditionally strong German industrial sectors and be integrated into conventional technology systems[11].

Industry 4.0 offers enormous potential for innovation and industry in Germany: around 15 million jobs are directly and indirectly dependent on the manufacturing sector. The digitization of the economy and industry not only changes value creation processes but also creates new business models and new perspectives for employees. Especially for small and medium-sized companies, intelligent, digital production can offer great opportunities[12].

5. Conclusion

The idea behind Industry 4.0 in terms of automation of production is not a purely German invention, it also takes place in some other countries across the world. The focus of German Industry 4.0 is always intense, socio-technical interaction between actors and resources involved in production. Industry 4.0 is a German innovation policy that is based on a consensus of stakeholder such as industry, and trade union. As an objective of the policy, it is always examined whether social goals such as employment can be achieved with it. More-so, the strategy of Industry 4.0 is based on SWOT analysis of German industry and innovation system. It is about the innovation system. The German innovation system is undoubtedly strong when it comes to the further development of existing knowledge - through its implementation of high-quality goods and services - either from within the country or from abroad. The
Characteristics of the German innovation policy in industry 4.0

classical characteristics of Industry 4.0 as a German innovation policy strategy lie in this strong German innovation system.

What does this policy mean for those countries that are trying to initiate a similar policy? Although many German companies already exhibit at fairs with supposedly successful Industry 4.0 solutions, it is necessary for the success of the policy to examine whether there are some necessary framework conditions for each country, such as in training, in application-oriented research for SMEs, etc.

References


